Pest Management Alliance Project Final Report
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Pest Management Alliance For The Containerized Nursery Industry

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Acknowledgments. We thank the participation in this project of the following containerized plant nurseries: Tree of Life Nursery, San Juan Valley, Orange Co.; El Modeno Gardens, Irvine, CA; Don's Wholesale Nursery, Anaheim; Sakaida Nursery, Trabuco Canyon; Color Spot Nursery, San Juan Capistrano; Skypark Nursery, Anaheim; the Pardee Tree Nursery, Bonsall; and Bordier's Nursery in Irvine. We also thank the South Coast Research and Extension Center, University of California, for use of their facilities for meetings and ongoing projects.

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Executive Summary

The Pest Management Alliance (PMA) for the containerized nursery industry has 5 main goals:

1. To encourage statewide adoption of reduced-risk, IPM practices by containerized nursery owners.
2. To expand and strengthen dissemination of IPM information to nursery growers.
3. To substantiate cost-effective reduced-risk practices through the use of demonstrations.
4. To develop reduced risk strategies that legally certify nursery shipments free of red imported fire ants.
5. To encourage water management practices that reduce pesticides and fertilizers in run off.

To meet these goals, the PMA had 2 major objectives for the first year. The **first major objective** was to find alternatives to the use of organophosphates and carbamate insecticides to control ants. Our accomplishments for this objective include:

1. The demonstration of improved methods of monitoring for red imported fire ants (RIFA), *Solenopsis invicta* Buren, in nurseries. Improved monitoring means that pesticides are used only when the pest is found, thereby reducing the use of pesticides. We chose nurseries that had been positive for RIFA. Our first monitoring method at the Tree of Life Nursery (Fig. 1) involved the placement of protein and sugar water bait stations every 20 ft in a grid pattern around the nursery. We did this monthly for 12 months and recorded all species of ants that we found. We never found RIFA subsequent to the original infestation, thereby preventing the application of pesticides every 3 months, as the state quarantine usually requires. We thus avoided the use of pesticides on 36 acres at this nursery during the year of monitoring. We have demonstrated that effective monitoring can substitute for quarterly broadcast pesticide applications.

   At 4 other nurseries in Orange Co. we did intensive monitoring for RIFA around new infestations. Our method of placing monitors in the pattern of a wheel around the find (Fig. 2) showed the extent of the infestation in each case, thereby justifying the use of pesticide in a small area around the infestations. These data have helped persuade state quarantine officials that monitoring for fire ants is reliable. Therefore, the requirement for quarterly broadcast of pesticides in nurseries has been relaxed and only the immediate vicinity of the infestation needs to be treated.

2. Evaluating possible alternatives to organophosphate and carbamate insecticides currently used for RIFA control. All nurseries infested with RIFA are immediately treated. Thus, to evaluate new products we ran several long-term studies at golf course communities in the Coachella Valley (Figs. 3 and 4). We have demonstrated that a new pesticide, fipronil, is effective against fire ants in California. This product has a much longer residual effect than other pesticides, thus reducing the frequency of treatments (once a year instead of 4 times a year, according to experts who have tested it in other states). The fipronil does not require turning off irrigation, as do other fire ant products. Fipronil will soon be on the market in California and will be available for fire ant control.

   In the laboratory we have also successfully shown the efficacy of 4 liquid toxicants for use in fire ant bait stations that avoid any ground contamination with pesticides. These toxicants will be field tested as sites in nurseries or golf courses are available. We have also evaluated 4 drench alternatives for potted soil for ant control. As we find promising materials we will lobby the USDA for changes in regulations regarding soil incorporation of pesticides.

The **second objective** was to help reduce the amount of insecticide runoff from nurseries. The fire ant quarantine at plant nurseries requires that bifenthrin or chlorpyrifos be added to potting soil to prevent colonization of fire ants. These products have been detected in water runoff from nurseries operating under the California Department of Food and Agriculture compliance program. Chlorpyrifos is an identified pollutant that has been found in various water bodies in the state and is a listed pollutant in the Newport Bay/San Diego Creek watershed TMDL, which is in the fire ant quarantine area. The initial task was to set up a nursery site to demonstrate the protection of surface and groundwater quality (El Modeno nursery). Pesticide runoff has been significantly reduced, with bifenthrin concentrations being reduced by 54%. The second phase was then to have grower forums and workshops to demonstrate these practices. Over 50 lectures, seminars, and workshops have included information fulfilling the objectives of the PMA grant (see Table 5).

We have added a **third major objective** that pertains equally to the first two: developing a website and newsletter for the PMA. We have set up a committee and workgroup to develop the web site, and have entered into a contract for its development. An agreement has also been reached with the California Association of Nurserymen (CAN) to host the website on their server.

Objective I. Alternatives to organophosphates and traditional pesticides.

Task 1. Improving Monitoring Techniques for Red Imported Fire Ants

A. Tree of Life nursery.

Two ant-monitoring techniques were employed at the Tree of Life Nursery in San Juan Valley to determine if native and invasive ant species were on the property. Tree of Life Nursery is situated on 36 acres of which 20 are in actual production (Fig. 1). RIFA, *Solenopsis invicta* Buren, were discovered on the property on November 1999, and the nursery has been monitored ever since. This nursery is also special because it specializes in plants for restoration projects and tries to maintain the property free of Argentine ants, *Linepithema humile* (Mayr). Consequently, this nursery was an ideal site for demonstrating various ant-monitoring techniques.

Initially the property was inspected by CDFA. Their monitoring technique is as follows: Approximately 3 g of Spam luncheon meat is placed in a small plastic cage. The cages are staked into the ground approximately every 50 ft in a grid (20 bait stations per acre) in areas suspected of having *S. invicta*. The monitor stations are placed out in the early morning about 0900 hours and the species of ant feeding on the Spam are recorded after 4-5 hours. The monitoring system is qualitative and no attempt is made to determine the number of ants present. Properties that are positive for *S. invicta* are monitored every 3 months as part of the Quarantine Procedure. Table 1 shows the species that CDFA identified at this location.

Pesticides were applied to the one location that had RIFA. Instead of treating the entire nursery, as normally required by the quarantine protocol, we received permission to substitute intensive monitoring of the nursery for wide-scale pesticide application. We placed 148 bait stations in a grid pattern along the rows of the nursery (see Fig. 1). We used two monitoring techniques to determine the presence of RIFA and other ant species, to look for seasonal patterns in bait attractiveness to the ants, and to see whether one technique was more sensitive than the other. Each station had one protein and one sugar water bait, placed side by side. The baits were covered with clay pots to protect them from water and animals. For the protein bait we used 9 Lives Cat Food ground to 18 mesh particle size; we filled a 15 ml tube approximately half way with the food. Next to it we placed vials of sugar water. Using liquids to monitor ant activity is based on a technique developed by Reierson *et al.* (1998) to monitor Argentine ant foraging activity. Conical vials containing 13 ml of 25% sucrose water are placed on pedestals. The vials are

covered with an inverted clay pot to protect them from irrigation and wild animals. The vials containing sugar water were placed out next to the solid baits and retrieved after 24 hours. The number of ants at each station and the species was recorded. The Tree of Life nursery was monitored monthly for one year.

Results. Table 1 shows the species originally found by CDFA with their Spam baits. Table 2 shows the numbers of ants collected at either the sugar water (L) or the cat food (S), and Table 3 shows the number of monitors positive for each species. The sugar water vials collected significantly more ants than did the solid baits for *Dorymyrmex bicolor* and *D. pyramidis*, *Tapinoma sessile*, *Formica pilicornis*, and *Solenopsis xyloni*. Neither bait was effective in sampling *Pogonomyrmex occidentale, Solenopsis molesta,* or *Cardiocondyla ectopia*.

The sugar water baits were extremely effective in determining if *D. bicolor*, *T. sessile*, *F. pilicornis*, and *S. xyloni* were present throughout the year (Table 3). Only on rare occasions were ants collected at the solid bait and not at the sugar bait. *S. xyloni* was frequently found on both baits, especially during summer months. In the winter months, the sugar water baits were the most effective for the species responding to either bait.

Our intensive monitoring of this location avoided wide-scale application of pesticides. It demonstrated that sugar water is a very effective monitor for many ant species any time of the year.

B. Wheel method for monitoring fire ants at nurseries.

One of the goals of monitoring for fire ants is delimiting the location of the ants in positive nurseries. Pesticide treatments can then be put only in those areas that have the ants. We designed a "wheel method" of monitoring fire ants where ant monitors are placed around a known infestation in the form of a wheel with 8 spokes (Fig. 2). The center of the wheel corresponds to the known ant colony and sugar water and luncheon meat monitors are then placed every 10 ft along the spokes of the wheel. We left the monitors for 24 hrs and then recorded where we found RIFA. In this way we got a precise picture of the infestation and the distance the ants were foraging. We tried this method at 4 nurseries: Don's Wholesale Nursery, Sakaida Nursery, Color Spot Nursery, and Skypark Nursery, all in Orange Co.

Results. We placed a total of 145 monitors in these 4 nurseries. We found RIFA either at or within 1 ft of the monitors at 18% of the bait stations. However, sugar water missed 27% of known RIFA locations, and the luncheon meat missed 38% of known RIFA locations. The meat and sugar water side by side only missed 12% of known RIFA locations. Thus, the two monitors together were more successful than either one alone. Finally, there were 160% more ants at the sugar water than the meat monitors. Thus we have shown that a sugar water and protein bait together is more efficient than either one alone.

There are a couple of likely reasons for failure to detect RIFA at these monitors. The most important is the presence of Argentine ants, which can chase RIFA from the monitors. Another possible reason is that fire ants that have been treated with pesticides may be queenless and not interested in feeding.

C. Monitoring at other nurseries.

The Pardee Tree Nursery in Bonsall, Orange Co., has adopted our technique of monitoring for fire ants using sugar water. They have laid out a grid of sugar water monitors at 50 ft intervals throughout their nursery as an early detection method for RIFA. Because of this monitoring state officials have not had to do additional surveys at this location.

Task 2. Replacement of Organophosphates and other Pesticides

A. Demonstrating the use of new RIFA products. We have run two demonstrations of the efficacy of fipronil at two country clubs in the Coachella Valley: Sunrise and Rancho Las Palmas, both in Rancho Mirage. At each of these locations we compared the efficacy of fipronil with the standard treatments in use by the eradication agencies. They typically apply baits containing an insect growth regulator (pyriproxyfen) followed a week later by a bait with hydramethylnon. These treatments are repeated every 3 months because they break down quickly and there is no residual action beyond a couple of days. On the other hand, granular fipronil binds tightly to the upper layer of soil and has an extended residual effect. This characteristic is important in preventing new reinfestations by fire ant queens that fly and drop into new areas, where they start new colonies. Figs. 5 and 6 show typical results.

B. Trials with liquid toxicants. Another plan to reduce pesticide usage is to use toxicants in sugar water bait stations, avoiding the use of any pesticides that touch the ground. We have begun laboratory and field-testing of toxicants in sugar water. We currently have 4 products with adequate water solubility for use in sugar water baits: boric acid, fipronil, thiomethoxam, and imidacloprid. In the laboratory, for each of these products we set up 10 petri dishes at each concentration of toxicant with 10 RIFA workers in each to measure the time to kill half of the ants (LT50). A second step was to set up mini-colonies consisting of 300 RIFA with a supply of the sugar water toxicant and we again measured time to kill half of the workers. We are currently doing the field-testing of these products at RIFA sites to demonstrate that the liquid toxicants can eradicate fire ants.

C. Drench Substitutes. The fire ant quarantine at plant nurseries requires that bifenthrin or chlorpyrifos be added to potting soil to prevent colonization with fire ants. These insecticides are showing up with water runoff. Our goal is to screen natural oils and non-pesticides to see whether we can find an alternative that would prevent ant colonization of potted plants. Thus far we have looked at Orange Guard (limonene), Nouguard (capsaicin), Exxant (a turpentine solution), and other plant oils. We put 300 ants into small pots with soil, added the liquid, and recorded either death of the ants or whether they left the pots. Thus far we have found that the limonene and turpentine solutions immediately cause the ants to leave the soil. Continued screening of these products should help to find reliable drench substitutes.

Objective II. Protection of surface water and groundwater.

Task 1. Demonstration of runoff mitigation.

A very successful pesticide runoff mitigation research and demonstration project has been implemented at a PMA member site (El Modeno Gardens, Irvine, CA). A multiple strategy plan was implemented utilizing several of the innovations listed in our PMA plan. These innovations were;

- Improve irrigation management techniques to reduce pesticide and fertilizer run off.
- Optimize timing of applications and select best fertilizer formulations to reduce nitrate levels in runoff.
- Use of vegetative border strips, grading, sand bags and holding ponds to reduce pesticide runoff.

Initially, one site was chosen to develop protocols and field experience with the management of the system. As part of their RIFA monitoring program, CDPR is monitoring pesticides in the runoff prior to entering the vegetative filter, which consists of a patented Canna Lily (Tropicana) and after exiting the vegetative filter. Canna lilies are planted in a cement drainage channel. Space for growing plants is in short supply, and the use of the drainage channel to grow a profitable patented plant variety has resulted in an economic incentive to implement the pesticide and nutrient mitigation and also has the added benefit of utilizing the nutrients, which would have run off the property as a pollutant. A grant from the CDFA FREP (Fertilizer Research and Education Program) is funding the constant flow monitoring and weekly nutrient monitoring of the runoff.

Dr. Kean Goh (California Department of Pesticide Regulation) noticed that even before the Canna plants were placed in the channel, our other mitigation efforts such as grading, building a sediment pond, and fine-tuning the nursery's irrigation system, resulted in a dramatic reduction in sediment and runoff. In the RIFA Project in Orange County, June 2001 (STUDY 183) Dr. Goh states: "During June 2001, surface water samples were collected from five sites in Orange County, California. Water samples collected from a mitigation filter strip planted with *Canna* showed a 54% reduction of bifenthrin concentrations (Table 4)."

Another phase of the project to be conducted in July of 2001 will be to reduce soil surfaces water flows over, and to use polyacrylamide to flocculate fine sediments out of the runoff water, which we believe will dramatically reduce the offsite movement of bifenthrin.

Task 2. Forums and workshops to disseminate information.

Over 50 lectures, seminars, and workshops have included information fulfilling the objectives of the PMA grant (see Fig. 6, Table 5). On September 14, 2000 the Nursery PMA conducted a workshop/conference at the University of California, Riverside. The workshop was attended by over 100 nursery and landscape professionals and dealt with the issues and challenges facing the nursery industry in California. Top experts in their areas gave presentations on subjects such as the Glassy Winged Sharpshooter, Red Imported Fire Ants, Pesticide Runoff, etc. A poster session was held at the end of the conference giving attendees and researchers a chance to interact. Evaluations overwhelmingly gave the workshop an excellent rating.

Objective III. *Setting up a Pest Management Alliance Website*

A contract has been finalized with Urban Integrated Forestry to develop a Pest Management Alliance Website and an agreement has been reached with the California Association of Nurserymen to host the website on their server. More details will be available shortly.

References Cited

Reierson, D.A., M. K. Rust and J. Hampton-Beesley. 1998. Monitoring with sugar water to determine the efficacy of treatments to control Argentine ants, *Linepithema humile* (Mayr)., pp. 78-82. *In* Proceedings of the National Conference on Urban Entomology.

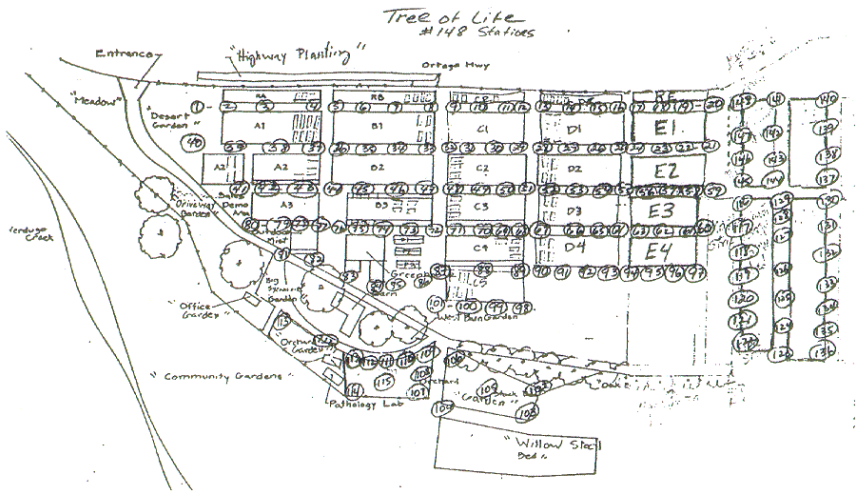


Figure 1. Tree of Life nursery, showing location of ant monitors.

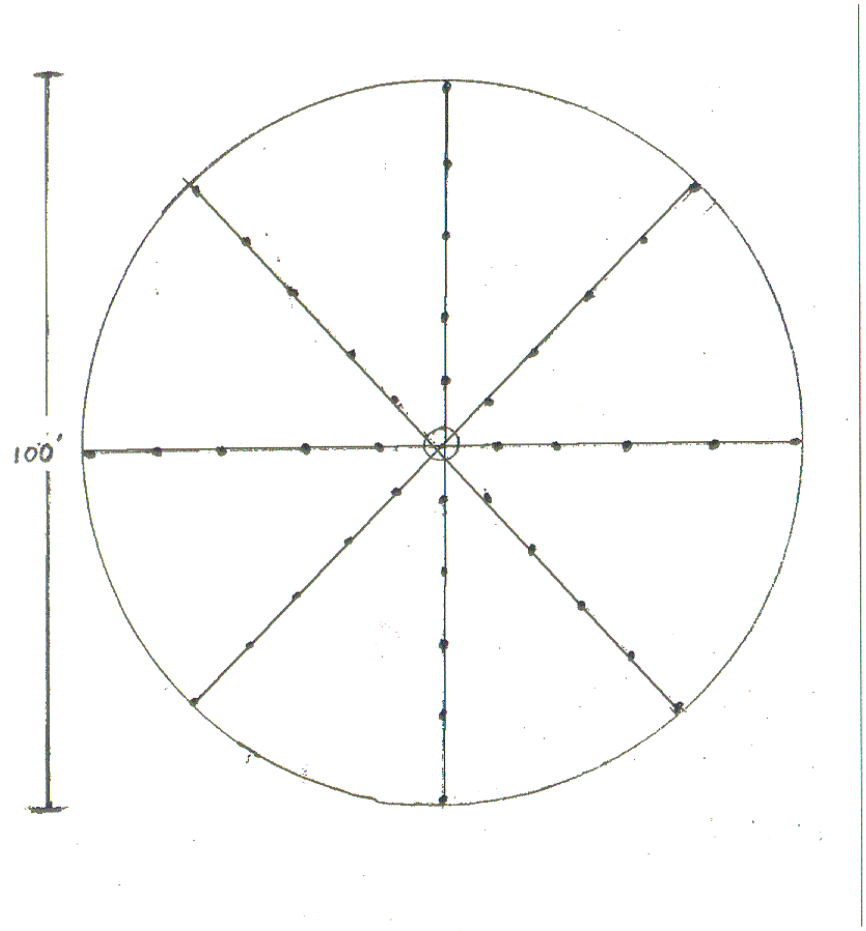


Figure 2. Wheel monitoring method. The known infestation is at the center; each spot represents a monitor location, spaced at 10 ft intervals.

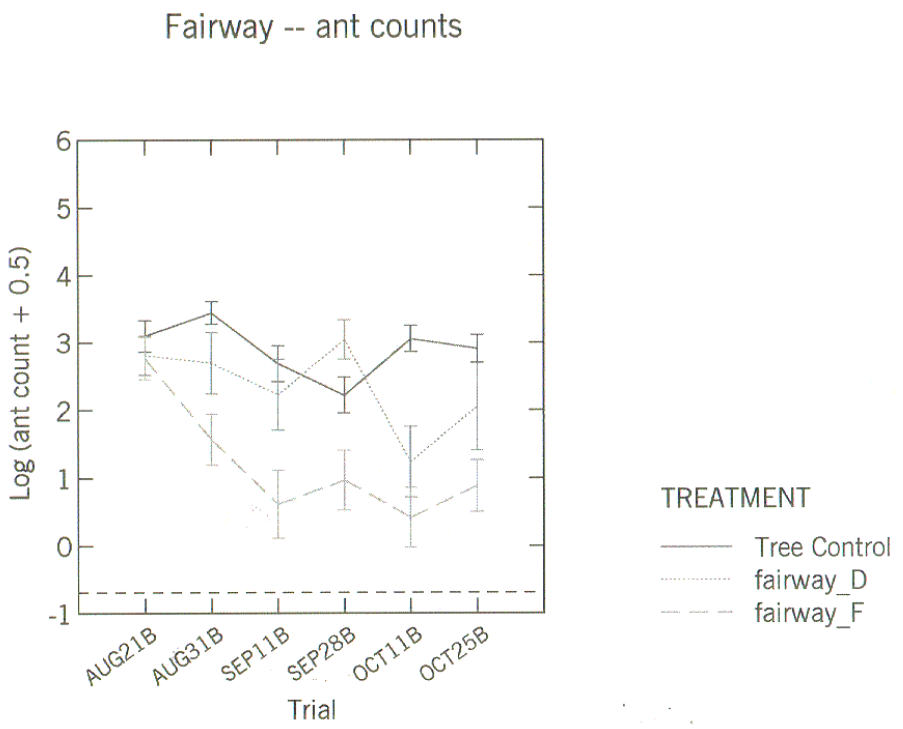


Figure 3. Comparison of fire ant counts after treatment with the standard treatment, Distance fire ant bait (D), and with fipronil granules (F), at Rancho Las Palmas Country Club.

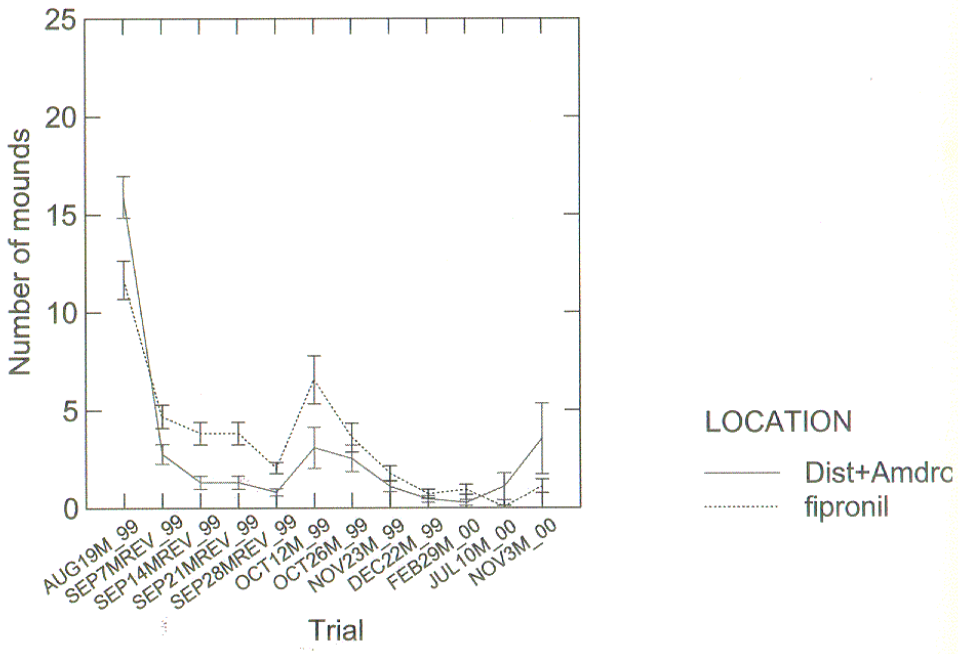
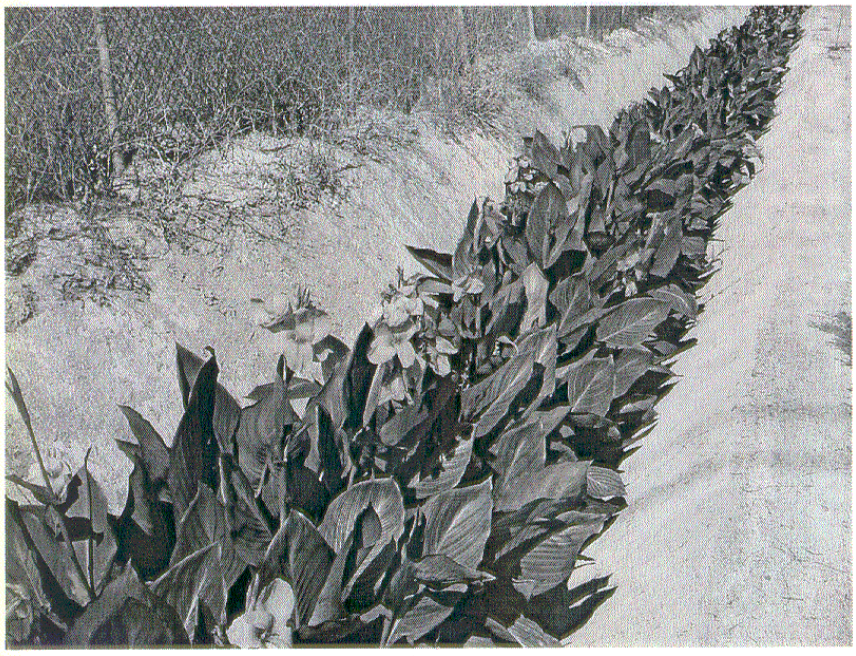


Figure 4. A comparison of standard treatments of Distance + Amdro baits with a single treatment of fipronil granules, at the Sunrise Country Club.



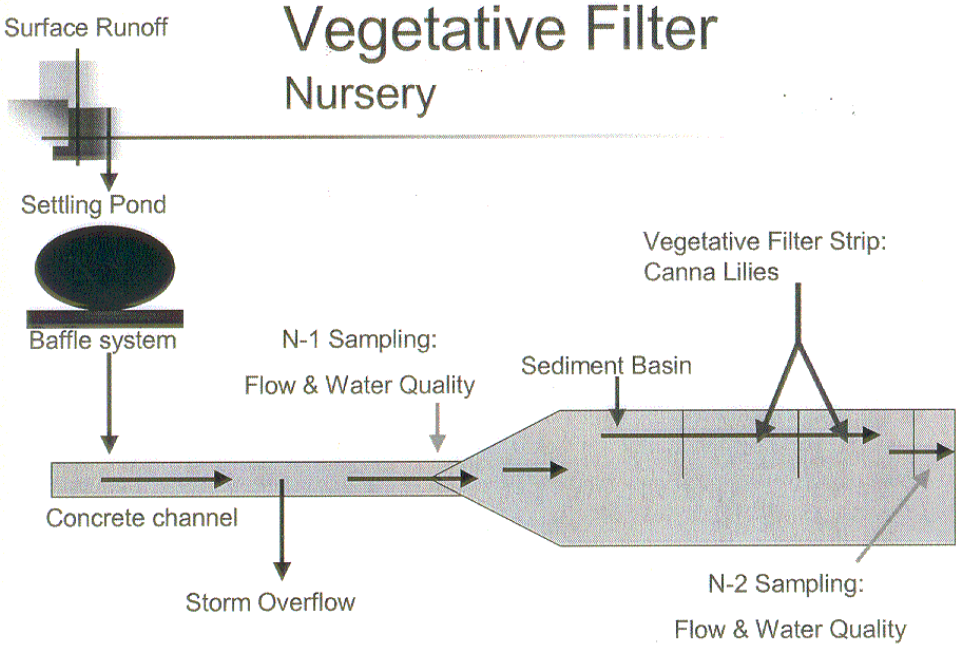


Fig. 5. Schematic and picture of Vegetative Filter at El Modeno Gardens, Irvine, CA.

Fig. 6. California Ornamental Research Foundation/Ornamental Horticulture Educational Continuing Conference Meeting at Bordiers Nursery and the South Coast Research and Extension Center, Irvine, California.

Table 1. Ant species collected at Tree of Life nursery.

Cardiocondyla ectopia Snelling
Dorymyrmex bicolor Wheeler (bicolored pyramid ant)
Dorymyrmex insana (Buckley) (pyramid ant)
Formica pilicornis Emery
Liometopum occidentale Emery (velvety tree ant)
Pogonomyrmex occidentalis (Cresson) (harvester ant)
Solenopsis molesta (Say) (thief ant)
Solenopsis xyloni McCook (Southern fire ant)
Tapinoma sessile (Say) (Odorous house ant)
*Linepithema humile (*Mayr) (Argentine ant)
Solenopsis invicta Buren (Red Imported Fire Ant)

Table 2. The species and number of ants collected at liquid and solid baits at Tree of Life Nursery. L = 25% sugar water; S = Nine Lives cat food.

	D. bicolor		*D. insana*		*T. sessile*		*F. pilicornis*		*S. xyloni*	
Date	L	S	L	S	L	S	L	S	L	S
14-Mar-00	1598	41	1	1	79	4	107	5	47	0
4-Apr-00	1707	23	25	2	132	21	132	9	112	3
3-May-00	1246	22	0	0	87	6	39	1	209	25
30-May-00	918	34	430	5	81	12	265	11	217	37
27-Jun-00	1059	75	0	0	85	31	108	5	126	20
1-Aug-00	1125	57	0	0	104	7	75	15	141	0
5-Sep-00	4068	382	0	0	246	6	303	1	523	75
3-Oct-00	2488	526	0	0	242	6	55	14	426	106
31-Oct-00	3963	37	0	0	143	2	42	0	31	5
5-Dec-00	2065	2	2	0	181	0	101	0	4	0
3-Jan-01	1505	21	0	0	0	0	46	0	15	10
6-Feb-01	974	2	0	0	61	0	412	0	40	2

Table 3. The number of monitors positive for each species and the (%) of sites for each date and species at either the 25% sugar water (L), Nine Lives cat food (S), or both (B).

	D. bicolor			*D. insana*			*T. sessile*			*F. pilicornis*			*S. xyloni*		
Date	L	S	B	L	S	B	L	S	B	L	S	B	L	S	B
14-Mar-00	15(47)	2(6)	15(47)	1(50)	1(50)		3(60)		2(40)	8(80)		2(20)	3(100)		
4-Apr-00	32(84)		6(16)	4(80)		1(20)	5(63)		3(37)	8(67)	1(8)	3(25)	3(60)		2(40)
3-May-00	34(76)	1(2)	10(22)				7(78)		2(22)	13(93)	1(7)		3(75)	1(25)	
30-May-00	34(76)	1(2)	10(22)	7(88)		1(12)	4(57)		3(43)	20(83)		4(17)	3(33)		6(67)
27-Jun-00	32(62)	1(2)	19(36)				3(60)		2(40)	9(69)	2(15)	2(15)	4(67)		2(33)
1-Aug-00	38(66)		20(34)				5(63)		3(37)	9(75)	2(17)	1(8)	6(100)		
5-Sep-00	36(52)	1(2)	32(46)				8(73)		3(27)	20(95)		1(5)	4(36)		7(64)
3-Oct-00	23(39)		36(61)				10(77)		3(23)	7(58)		5(42)	3(27)		8(73)
31-Oct-00	45(90)		5(10)				11(92)		1(8)	4(100)			2(67)		1(33)
5-Dec-00	32(94)	1(3)	1(3)	1(100)			4(100)			9(100)			1(100)		
3-Jan-01	20(67)	5(17)	5(17)							7(100)					1(100)
6-Feb-01	20(91)	1(5)	1(5)				5(100)			13(100)					1(100)

Table 4. Insecticide concentrations at mitigation site, June 2001, Orange County, California.

Location	Concentration (ppb)								
	bifenthrin	fenoxycarb	hydramethylnon	pyriproxyfen	chlorpyrifos	diazinon	dimethoate	malathion	methidathion
Surface Water Samples									
Filter strip inflow	0.516	ND[1]	ND	ND	ND	ND	0.053	0.388	ND
Filter strip outflow	0.234	ND	ND	ND	ND	0.044	ND	0.572	ND

1 ND = none detected at the reporting limit for that chemical.

Table 5. List of meetings related to PMA activities.

Hosted by John Kabashima:				
Newport Bay Total Maximum Daily Loads (TMDLs)	UC Conference	2/25/00	75	Salinas, CA
RIFA	UCR Urban Entomology Conference	3/28/00	125	Riverside, CA
Newport Bay Watershed Nutrient Mgmt Plan	Irvine Ranch Water District Board of Directors	4/12/00	5	Irvine Ranch Water District, Irvine, CA
Red Imported Fire Ant (RIFA) Hands on Training for CDFA, County and Fire Ant Authority inspectors	California Department of Food and Agriculture, County Agriculture Commissioners, Fire Ant Authorities	4/20/00	200	South Coast Research and Extension Center (SCREC), Irvine, CA
RIFA /Pesticide Briefing	Sat Tamaribuchi, VP Environmental Affairs, The Irvine Company	5/01/00	1	SCREC, Irvine, CA
Pesticide Runoff Issues	So Cal CAPCA Spring Seminar	5/25/00	55	SCREC, Irvine, CA
How to Diagnose and Treat Pest Problems	California Association of Nurserymen (CAN) CCN Pro Training	8/30/00	90	Ontario, CA
RIFA Briefing	Calif. Secretary of Agriculture Bill Lyons	9/05/00	2	SCREC, Irvine, CA
RIFA Briefing	Assemblyman Bill Campbell	9/06/00	2	SCREC, Irvine, CA
Co-sponsored by CDPR/PMA, All day seminar and poster session on Nursery Pest Management, Exotic Pests, and TMDLs	CAN Ornamentals Conference	9-14-00	100	Riverside, CA
UCCE TMDL projects overview	Regional Water Quality Control Board Public Hearing	10/6/00	50	Loma Linda, CA
New Pests, RIFA Lecture	Fall Arboriculture Seminar	10/20/00	75	San Diego
Newport Bay/San Diego Creek TMDL	CDFA FREP Conference	11/14/00	150	Bakersfield, CA
IPM Seminar	California Rare Fruit Growers Seminar, Cal State Fullerton	11/18/00	75	Fullerton, CA
TMDLs	UC Davis Vegetable Workgroup	12/06/00	55	UC Davis
Exotic Pests, Pollution Prevention	Bordiers Nursery Staff Meeting	01-12-01	22	Irvine, CA
Frost Protection Techniques to Minimize Water Runoff	University of California Cooperative Extension (UCCE) TMDL Education Series	01-26-01	25	SCREC, Irvine, CA
CDFA Inspector Training	CDFA/UCCE Ag Inspector Training Workshop	01-30-01	65	SCREC, Irvine, CA

CDFA Inspector Training	CDFA/UCCE Ag Inspector Training Workshop	01-31-01	60	SCREC, Irvine, CA
Emerging Issues in Surface Water Quality	UC Division of Agriculture and Natural Resources (DANR) Statewide Conference	02-22-01	75	Riverside, CA
Moderator – Exotic Pest Session	DANR Statewide Conference	02-22-01	75	Riverside, CA
Moderator – Exotic Pest Session	DANR Statewide Conference	02-23-01	75	Riverside, Ca
Entomology Lecture	OC UCCE MG Training Class	03-17-01	53	Costa Mesa, CA
TMDL lecture and Tour	California Ornamental Research Foundation/Ornamental Horticulture Educational Continuing Conference Mtg	03-23-01	25	Irvine, CA
TMDL Project Lecture	IRWD Board	04-11-01	10	Irvine, CA
RGLP Interview	Interview by Mike Anton, LA Times	04-12-01	1	Irvine,CA
Lecture and Tour of Env. Hort./Natural Resources In Orange County	UC DANR VP Lanny Lund Tour	04-23-01	5	Orange County, CA
Nursery Pesticide Mitigation Lecture and Tour	TMDL Update	05-09-01	14	Irvine, CA
Research Update	So. Cal. CAPCA	05-17-01	50	Irvine, CA
Greenhouse Whitefly Biology and TMDL Workshop	Greenhouse Whitefly Mtg	05-18-01	20	Irvine, CA
Overview of NPDES/TMDL and Govt. Agency Pesticide Use	Countywide IPM Meeting	06-05-01	20	Anaheim, CA
Pesticide Runoff Mitigation	San Diego CAPCA Mtg	06-06-01	100	Encinitas, CA
Hosted by Cheryl Wilen:				
Starting out right: Basics of IPM	Port of San Diego IPM Training	5/2/00	150	San Diego
Weed Ecology	Pesticide Applicators Professional Association Hands-On Seminar	5/25/00	45	Los Angeles
Nutsedge Control In Cut Flowers	CAPCA Spring Seminar	5/25/00	55	Irvine
Southern California Pest Management Trials	CAPCA Nursery/Greenhouse Seminar	6/7/00	90	San Diego
Pesticide Safety Training	Landscape/nursery trainees	6/27/00	15	Los Angeles
Implementing IPM to minimize urban pesticide use	CAN/CCN Pro Training	8/30/00	90	Ontario
Non-traditional Weed Control Techniques	UCR Landscape Reseach and Field Day	9/13/00	200	Riverside

Exotic Pests: invasive plants	CAN/UC/CDPR Nursery Research Conf.	9/14/00	200	Riverside
Residential Pesticide Use in Orange County-Preliminary Results	TMDL Workgroup for Newport Bay	11/1/00	30	Irvine
Biology and Control of Yellow Nutsedge	Salinas Valley Weed School	11/29/00	30	Salinas
Innovations in IPM for Nurseries	Target Nursery Meeting	12/5/00	15	Riverside
TMDLs and Pesticide Properties	CAPCA Laws and Regs	12/14/00	40	San Diego
Weed Control	Master Gardener Training	3/25/00	35	Irvine
Pesticide Safety Training, IPM Training Workshops	CDC workers/trainees	6/27/00	15	Long Beach
The Glassy Winged Sharpshooter	Master Gardener Training	8/24/00	25	Riverside
Weeds and Their Control	Master Gardener Training	11/15/00	40	Loma Linda
New Pests and Issues for Nurseries	Target Specialty Products Seminar	2/7/01	35	Long Beach
IPM and TMDLs for Nurseries	UCCE training meeting	3/23/01	40	Irvine
Alternatives to Pesticides	ROPS Training Class	5/11/01	25	Chula Vista
Pests and Plant Nutrition	CCA Seminar	5/16/01	50	Carlsbad

Table 5 Addendum: Presentations by Les Greenberg on RIFA

September 14, 2000. Ornamental Horticulture Conference, UC Riverside. "Update on Red Imported Fire ants." 20 min.
October 31, 2000. Target's 28th Annual Seminar & Exhibit, Ontario, CA. "Fire Ant Update". Also poster display.
December, 2000. Finished writing RIFA pest note for DANR.
January 23, 2001. Presentation about fire ants for city of Santa Monica environmental division.
Feb. 5., 2001. Gave 45 min talk to Association of Applied Insect Ecologists 35th Annual Meeting. Possibilities of biocontrol of fire ants. Riverside, CA.
Feb. 7, 2001. 30 min talk for Target's 29th Annual Seminar & Exhibit, Long Beach Convention Center. Fire ants and nursery plants.
Feb. 7, 2001. 30 min talk for Target's 29th Annual Seminar & Exhibit, Long Beach Convention Center. Fire ants and nursery plants.
February 23, 10:50–11:10 am. DANR conference, Riverside. Fire ant update.
March 2, 2001. Gave talk at national fire ant meetings in San Antonio, TX: "Monitoring fire ants in California".
March 6 and 7, 2001. Participated in County training workshops, section on fire ants, for CDFA, under direction of John Blasius, at Palm Desert, CA.
March 29, 3:15 pm. 10th Annual Urban Pest Management Conference, Riverside. Fire ant update.
March 31, 2001. Presentation on fire ants, along with Larry Cooper of CDFA, Dorsey High School, Los Angeles.
May 29, 2001. 30 min workshop about ant identification and biology for Riverside Co. Ag. Commissioners's office, Riverside.
June 26, 2001. Invited speaker in urban entomology section of Pacific Branch meeting of the Entomological Society of America, Park City, Utah. "Status of the Red Imported Fire Ant Invasion of California."